METHYL BROMIDE CRITICAL USE RENOMINATION FOR POST-HARVEST -- DRY CURED PORK PRODUCTS

NOMINATING PARTY: The United States of America

FILE NAME USA CUN15 **POST HARVEST -- DRY, CURED PORK PRODUCTS**

BRIEF DESCRIPTIVE TITLE OF NOMINATION:
Methyl Bromide Critical Use Nomination for Post Harvest Use on Dry Cured Pork Products (Submitted in 2013 for 2015 Use Season)

STRUCTURE, COMMODITY OR OBJECT TREATED:

This sector is for the production of dry cured pork products, such as country hams. These are produced primarily in the southern U.S. This sector has no known viable alternative currently available.

QUANTITY OF METHYL BROMIDE REQUESTED IN EACH YEAR OF NOMINATION:

TABLE 1: QUANTITY OF METHYL BROMIDE REQUESTED IN EACH YEAR OF NOMINATION

YEAR	NOMINATION AMOUNT (KILOGRAMS)
2015	3,240 kg

(Details on this page are requested under Decision Ex. I/4(7), for posting on the Ozone Secretariat website under Decision Ex. I/4(8).)

In assessing nominations submitted in this format, TEAP and MBTOC will also refer to the original nomination on which the Party's first-year exemption was approved, as well as any supplementary information provided by the Party in relation to that original nomination. As this earlier information is retained by MBTOC, a Party need not re-submit that earlier information.

NOMINATING PARTY CONTACT DETAILS:

Contact Person:	Federico San Martini, Ph.D.
Title:	Foreign Affairs Officer
Address:	Office of Environmental Policy U.S. Department of State 2201 C Street, N.W. Room 2657 Washington, D.C. 20520 U.S.A.
Telephone:	(202) 647-3819
Fax:	(202) 647-1052
E-mail:	SanMartiniFM@state.gov

Following the requirements of Decision IX/6 paragraph (a)(1) United States of America has determined that the specific use detailed in this Critical Use Nomination is critical because the lack of availability of methyl bromide for this use would result in a significant market disruption. ■ *Yes* ☐ *No*

_________________________ ___________________________ ______________

Signature Name Date

Title: ____

CONTACT OR EXPERT(S) FOR FURTHER TECHNICAL DETAILS:

Contact/Expert Person: Mark A. Hartman
Title: Acting Director
Address: Biological and Economic Analysis Division
Office of Pesticide Programs
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W. Mailcode 7503P
Washington, D.C. 20460
U.S.A.
Telephone: (703) 308-0734
Fax: (703) 308-7042
E-mail: Hartman.Mark@epa.gov

LIST OF DOCUMENTS SENT TO THE OZONE SECRETARIAT IN OFFICIAL NOMINATION PACKAGE:

1. PAPER DOCUMENTS: **Title of paper documents and appendices**	**No. of pages**	**Date sent to Ozone Secretariat**
2. ELECTRONIC COPIES OF ALL PAPER DOCUMENTS: ***Title of each electronic file (for naming convention see notes above)**	**No. of kilobytes**	**Date sent to Ozone Secretariat**
USA CUN15 Post Harvest Ham		

* Identical to paper documents

METHYL BROMIDE CRITICAL USE RENOMINATION FOR POST-HARVEST -- DRY CURED PORK PRODUCTS

1. SUMMARY OF NEED FOR METHYL BROMIDE AS A CRITICAL USE

Currently there are no viable alternatives to methyl bromide for the dry cured pork industry: heat would alter the product, and phosphine has failed to control mites, a major pest. Sulfuryl fluoride received federal registration and has been tested for efficacy against mites and other pests of dry cured pork products. Although mortality of the red-legged ham beetle occurred at levels below maximum rates of sulfuryl fluoride, the same cannot be said for the ham mites (Phillips, et al., 2008). Control of the ham mites took three times the legal limits of sulfuryl fluoride (Phillips, et al., 2008). Preliminary work by Zhao et al (2012a) indicates that there may be other methods to control mites. At the time of this nomination, there are no known registered alternatives for use on dry cured pork in the United States that provide the same level of mite control as methyl bromide.

This industry is cooperating with university researchers to find technically and economically feasible alternatives to methyl bromide. Dry cured pork producers no longer fumigate with methyl bromide on a monthly schedule, but monitor and fumigate when pests are detected. Many producers use pheromone traps to monitor for pests (Arthur and Phillips, 2003). Producers improved sanitation in their curing facilities. Producers have modified their buildings to make them more gas-tight, not only to try to exclude pests, but also to retain methyl bromide better. Some companies eliminated grass, trees, and shrubs adjacent to their buildings and replaced them with gravel, as suggested by researchers in 2008, to reduce harborage for pests outside their aging houses. These efforts have reduced their use of methyl bromide, but have not eliminated the need to disinfest their dry cured pork products.

This industry currently has no viable chemical or non-chemical alternative available. Although some measures, listed in the above paragraph, have minimized the frequency fumigation is needed in some facilities, it has not eliminated the need for fumigation. Therefore, methyl bromide remains critical to this industry.

TABLE 2. NOMINATION AMOUNT

SECTOR		HAM Sector Total
Quantity Requested for 2014:	Amount (kgs)	3,730
Quantity Recommended by MBTOC/TEAP for 2014 :	Amount (kgs)	2,466
Quantity Authorized by Parties for 2014:	Amount (kgs)	3,730
	Volume (1000 m^3)	not stated
	Rate	not stated
Transition from 2014 Baseline Adjusted Value	Percentage (%)	13%
Quantity Required for 2015 Nomination:	Amount (kgs)	**3,240**
	Volume (1000 m^3)	see Table 3
	Rate	see Table 3

2. SUMMARIZE WHY ALTERNATIVES ARE NOT FEASIBLE

This industry currently has no viable chemical or non-chemical alternative available. Although IPM measures have minimized the frequency fumigation is needed, it has not eliminated the need for fumigation. Therefore, methyl bromide remains critical to this industry.

3. UPDATE OF RESEARCH RESULTS SHOWING EFFICACY OF ALTERNATIVES

Researchers are actively investigating the control of arthropod pests that infest dry cured pork products during the aging process.

Research Results

A series of laboratory experiments (Zhao et al 2012a) were conducted in which 1-cm square cubes of ham were dipped into a test compound of a given concentration for 1.0 minute and then placed in a ventilated glass jar and inoculated with 20 adult mites. Jars were held for 14 days to allow for mite reproduction and population growth, after which the total number of mite adults and nymphs were counted and compared to numbers produced on other treated ham pieces and on control hams dipped in water only. Three groups of experiments were conducted that compared common food oils, synthetic polyols and common legal food preservatives. Among oils tested, 100% lard from pork fat completely prevented mite reproduction on treated ham pieces, while vegetable oils such as olive, corn and soybean had minimal effects on mites. Of the polyols, glycerol had little effect on mites while propylene glycol at 100% or 50% prevented mite reproduction. Other short-chain di-ols had significant effects on mite reproduction. Of the other food preservatives tested, the various salts of sorbic and propionic acids were effective at preventing mite growth when applied as 10% solutions in water. Research so far suggests that approved food oils and synthetic food preservatives show potential for protecting dry cured hams from mite infestation, and future work will need to address the effects of these additives, if any, on the quality of hams during the aging process and on consumer acceptability.

In additional studies (Zhao et al 2012a), ham slices and 1-cm square cubes were dipped directly into either mineral oil, propylene glycol, 10% potassium sorbate solution or glycerin for 1 minute and dripped on a mesh colander for another minute. Lard was applied directly by rubbing a thin layer to cover the whole piece. Ham cubes (2.5 cm ×2.5 cm × 2.5cm) were used for the mite infestation study. During the study, 20 mites (mostly adult female) were placed on one cube of ham which was placed in a ventilated, mite proof glass container and incubated for 21 days at 27ºC and 70% relative humidity. Mite populations on ham cubes were counted every week. Coatings on ham slices were washed off before cooking. Ham slices were oven baked to internal temperature of 71˚C and served to trained panelists for sensory Difference from Control tests. A randomized complete block design with 3 replications was used to determine if differences ($P<0.05$) existed between treatments with respect to mite number and sensory differences between products.

Results indicated that both lard and propylene glycol were effective ($P<0.05$) at controlling mite reproduction. No difference was detected in sensory characteristics between control ham slices and samples treated with food grade ingredients. In addition, potassium sorbate and mineral oil did not inhibit mite reproduction but slowed mite growth ($P<0.05$) when compared to the control, and glycerin was ineffective at lowering mite counts ($P>0.05$) when compared to the control.

The majority of research that has been conducted on use of food grade ingredients with meat products has been to prevent water loss and reduce rancidity of meat products (Baldwin, 2007). However, a finished ham product needs to lose at least 18% of its original weight during aging (USDA, 1999). At the same time, the unique flavors of dry cured ham are caused by proteolysis and lipolysis with the presence of oxygen. In this case, water vapor permeability of the films and coatings needs to be considered when choosing a proper coating. Current and future research is being conducted to develop a cost-effective food grade coating with high oxygen and water vapor permeability.

Based on the research studies described above (Zhao et al 2012a), the active ingredients that show the most promise as potential methyl bromide alternatives are propylene glycol, butylated hydroxytoluene (BHT), and lard. Propylene glycol (PG) is likely the most feasible food-grade ingredient that could be used to control ham mites but is also very expensive. BHT is effective at controlling mites on 1 inch ham pieces at a concentration of 10 %. However, 0.01 % BHT (by fat percentage) is the acceptable level in some meat products. This makes it unlikely that it would be accepted for use, but may have application if it can be washed off the surface and there is less than 0.01 % BHT in the finished product. Lard was effective at controlling mites on ham pieces. However, use of lard may prevent moisture loss and transmission of oxygen which would prevent the preservation and flavor development of the ham. However, these 3 ingredients need to be evaluated on whole hams for their ability to control mite infestations. In December of 2012, research was started on whole hams such that the hams are treated with BHT, lard, or propylene glycol. Hams will be infested with a known number of mites and evaluated over 3 weeks for the number of mites on the hams. In addition, propylene glycol will be used in food-grade gel coatings to determine if incorporating PG in a gel will prevent evaporation of the PG and prolong its effectiveness at controlling mites. We will also work with processors to implement PG and other food grade products that may control mites in their plants to determine their impact in industrial settings.

Development and use of a simple, low-cost trap for monitoring populations of ham mites in ham production facilities.

Dr. Phillips' research group (Zhao et al 2012b) developed a mite trap based on the basic design of a trap first developed in England. This trap consists of a 90 mm disposable plastic Petri dish that is painted black on the entire outer surface. Around the sidewall of the dish are eight evenly spaced holes, approximately 0.5 mm in diameter, at 2 mm above the bottom of the dish for entry of responding mites. A food bait was placed inside the middle of the dish and was a 25 mm diameter circular plug of mite diet, approximately 10 mm high. Mite diet was composed primarily of ground dog food with yeast, glycerin, anti-fungal agent and gelled with 2% agar. Mites respond to the baited dishes, enter the holes in the side wall, and feed to the diet plug where they mate and lay eggs. Laboratory studies confirmed that traps baited with diet were highly attractive to mites compared to unbaited traps. A study was initiated to monitor mite populations in which twenty traps were distributed evenly throughout each of three different ham production facilities for consecutive one-week periods. Mite numbers lured to traps varied from zero to several hundred in one week, and seasonal trapping determined that certain areas of facilities had higher mite activity than other areas. Traps confirmed that fumigation in certain circumstances caused severe reduction in mite populations, and showed that mites would slowly increase activity following fumigation. Future work will attempt to correlate mite trap counts with other direct measures of mite density, and also utilize such information to aid in IPM decisions. In addition, mite traps will be placed in additional processing facilities to determine mite numbers in facilities in different areas in the Southeastern United States both prior to and after fumigation.

Three fumigations trials (Zhao et al 2012b) were conducted in 1000-cubic feet shipping containers intended to simulate dry cured aging ham houses with phosphine concentrations ranging between 1000-2000 ppm and exposure time of 48 hours. Ten dry cured hams were hung from racks in each shipping container to simulate dry cured aging conditions. Twenty *Tyrophagus putrescentiae* (ham mites) bioassay jars and ten *Necrobia rufipes* (red-legged ham beetles) jars were placed in each shipping container for each trial. Five of these hams were used for mite inoculation and the other 5 hams were used for sensory analysis and phosphine residue testing. The lean portion of the dry cured hams (that were used for inoculation) was also inoculated with a mixed culture of approximately 1000 mites. Temperature was recorded in the ham houses during fumigation.

There were three treatments in each trial: control (no fumigation), low phosphine, and high phosphine. Three shipping containers were used during each trial. Phosphine gas was produced in the shipping containers using magnesium phosphide cells that reached target fumigation doses at between 8 to 12 hours after the fumigation was started. Phosphine concentration was measured in the shipping containers using both Dräger tubes and a calibrated UV-VIS detector after 48 hours fumigation. Average concentration of the three trials after 48 hours fumigation for low phosphine treatment (52 grams of magnesium phosphide) was about 1300 ppm. For high concentration fumigation treatment (140 grams of magnesium phosphide), average concentration was about 1600 ppm.

The mite mortality was 99.8 % in the bioassays at two weeks post fumigation when 2000 ppm phosphine was achieved, but not all eggs on either the hams or in the bioassays was controlled, even at concentrations as great as 2000 ppm. A lengthier fumigation time was attempted during early November, but the ambient temperature was too cold (<15ºC) to achieve successful control of ham mites. At temperatures of 20ºC or greater, all life stages of red-legged ham beetles were controlled in all fumigation trials. Variations in test conditions indicated that temperatures and exposure time need to be optimized for fumigation since 48 hours was not long enough to control ham mites at 2000 ppm and ambient temperatures below 15ºC decreased the effectiveness of the fumigation against both ham mites and red legged beetles.

Ham slices were oven baked to an internal temperature of 71˚C and served to trained panelists. A randomized complete block design with three replications was used to determine if trained panelists (n=6-8) could detect a difference between fumigated and non-fumigated hams in sensory difference from Control Tests. Sensory tests indicated that trained panelists could not determine differences (P>0.05) between phosphine treated dry cured hams and non-fumigated hams In addition, residual phosphine concentration was below the legal limit of 0.01 ppm in ham slices that were taken from phosphine fumigated hams. Further research is underway to determine if phosphine can be used at the plant level to control ham mite infestations.

One phosphine fumigation trial (Zhao et al 2012b) was conducted in a 36,000 cubic foot processing facility at 1600 ppm. Ham mite assays with live mites were distributed throughout the aging room. After 48 hr of fumigation at 1600 ppm (80 F, 70-80 % RH), there were no living ham mites in the assays. However, phosphine fumigation corroded the electrical switches to the fans, and these switches had to be replaced. In addition, the research needs to be repeated when many hams are infested with mites to determine if it is effective in real world situations. In addition, if phosphine is going to corrode and incapacitate electrical equipment, it will not be adaptable to the industry. Sensory panels were conducted to verify that fumigation with phosphine did not change the sensory profile of the hams. In this testing, trained panelists could not determine differences (P>0.05) between phosphine treated dry cured hams and non-fumigated hams.

Current Research Objectives

The USDA-Methyl Bromide Transition program funded a proposal with the following objectives that is being conducted from 2011-2013, with a potential no-cost extension into 2014. This research will start in January 2013 and is a collaborative effort between Mississippi State University, Kansas State University, and Oklahoma State University.

Methyl Bromide Transition Grant Objectives

1) Conduct research on the application and effectiveness of phosphine fumigation against *Tyrophagus putrescentiae* (ham mites) and *Necrobia rufipes* (red-legged ham beetles) under controlled simulated commercial conditions and true commercial applications in ham-curing facilities. Pest mortality, sensory quality, presence of residual chemicals and acceptability and appropriateness of phosphine for commercial users will be evaluated. Extension materials will be generated from this research to provide practical application and safety practices for phosphine fumigation of ham facilities.

2) Conduct exploratory research on simple, effective, non-chemical methods to prevent or stop ham mite infestations. A) Determine the effect of cold temperature on *Tyrophagus putrescentiae*, ham mite, and *Necrobia rufipes*, red-legged ham beetle (RHLB) mortality, and also determine the sensory quality of cold-treated hams. B) Treat hams with food grade oils and propylene glycol to evaluate their effectiveness at preventing and/or eliminating ham mite infestations. Sensory quality and market acceptability will also be evaluated for these hams.

3) Conduct research and extension activities with respect to the key components for Integrated Pest Management (IPM) in ham-processing facilities targeted at ham mites and RLHBs as the key pests. Assist companies in adapting HACCP-based IPM plans to their specific food plant and produce concise extension publications and develop hands on training programs for IPM in dry-cured ham facilities.

4) Perform economic cost-benefit and risk analyses comparing methyl bromide to alternatives such as phosphine, CO_2, and ozone as well as IPM programs. Effects on product quality will be an important factor in these analyses. The practical results of these studies will be integrated into the extension programs that are developed for dry-cured ham IPM and fumigation programs.

Results through 2010

Researchers have investigated the control of arthropod pests that infest dry cured pork products during the aging process. In the spring of 2007, a proposal was submitted to the USDA CSREES Integrated Research, Education, and Extension Competitive Grants Program- Methyl Bromide Transitions by several meat scientists and an entomologist. This proposal was funded from 2007 to 2010. A no-cost extension was granted for 2010-2011, and additional funding has been provided through the Southern Regions Integrated Pest Management Center to continue research efforts for 2010 and 2011. In addition, a grant was submitted to the USDA in summer 2011 to seek funds to continue research with respect to potential alternatives to methyl bromide for use in the dry cured pork industry. All of the research projects listed above and below are being conducted in conjunction with the National Country Ham Association, The American Association of Meat Processors, individual ham producers, and the fumigation and pest control industries.

There were several objectives to the research project that was funded by the USDA MBT program from 2007-2010. The first objective was to determine the effectiveness of chemical controls (sulfuryl fluoride, phosphine, and methyl bromide) against all life stages of both mold mites (*Tyrophagus putrescentiae*) and red legged ham beetles (*Necrobia rufipes*). The second objective was to determine the effectiveness of carbon dioxide and ozone against all life stages of both mold mites and red legged ham beetles. The third objective was to test the effects of sulfuryl fluoride, phosphine and methyl bromide on the quality and safety of the dry cured hams. The fourth objective was to conduct an economic analysis of the alternatives demonstrated to be technically viable alternatives for methyl bromide in this industry.

The results of sulfuryl fluoride efficacy investigations on *Tyrophagus putrescentiae*, ham mite, and *Necrobia rufipes*, red-legged ham beetle, were presented at the 2008 MBAO Conference, in Orlando, FL. The studies included eggs and a mixture of adults and large nymphs of mites and the eggs, large larvae, pupae and adults of beetles. The experiments were conducted for 48 hours at 23°C at various concentrations of sulfuryl fluoride. The investigators achieved 100% mortality of red-legged ham beetle adults and pupae at about 4.0 g/m^3, and 100% mortality of larvae at 5.7 g/m^3. Eggs of red-legged ham beetles died at 24.0 g/m^3 of sulfuryl fluoride, well below the maximum label rate (Phillips et al., 2008). Mortality of ham mites required much higher concentrations of sulfuryl fluoride. A concentration of about 100.3 g/m^3 was necessary to obtain 100% mortality of adults and nymphs under the test conditions. However, this concentration obtained only a 95% mortality of mite eggs. This is about three times the legal label rate of sulfuryl fluoride (Phillips et al., 2008) and thus indicates that sulfuryl fluoride is not a viable alternative to methyl bromide for controlling ham mites. In addition, results also indicated that levels of residual fluoride ion and sulfuryl fluoride in the hams were linearly related to fumigant concentration and that use of high concentrations of sulfuryl fluoride (72 g/m^3 or greater) and multiple fumigations could potentially lead to high concentrations of sulfuryl fluoride and fluoride in the ham (Sekhon et al., 2010a).

The results of investigations with carbon dioxide, phosphine, methyl bromide and ozone treatments on *Tyrophagus putrescentiae*, ham mite, and *Necrobia rufipes*, red-legged ham beetle, were presented at the 2009 MBAO Conference, in San Diego, CA (Sekhon et al., 2009a, b; Phillips, 2009, Phillips et al. 2011, Sekhon et al., 2010b, 2010c). The studies included eggs and a mixture of adults and nymphs of mites and eggs, large larvae, pupae and adults of beetles. The experiments were conducted for variable times at 23°C at various concentrations of carbon dioxide, phosphine, methyl bromide and ozone. The investigators achieved mortality of all life stages of mites with a concentration of 60 % carbon dioxide with 144 hr of exposure (Sekhon et al., 2009a; Phillips, 2009; Sekhon et al., 2010b). However, fumigation with carbon dioxide would likely not be applicable since ham structures are not air-tight and 144 hr is too long of a time to fumigate the hams. In addition, a carbon dioxide concentration (> 80 %) with an exposure time of 144 hrs was necessary to cause 100 % mortality for all life stages of red legged ham beetles (Sekhon, et al. 2009a; Phillips, 2009; Sekhon et al, 2010b). In addition, there may be higher numbers of ham mites that can hide in the crevices of the ham that may be able to survive during CO_2 fumigation. Investigators achieved 100 % mortality of all life stages of red-legged ham beetles and ham mites with 48 hours exposure of 400 and 1000 ppm of phosphine, respectively (Sekhon, et al. 2009b; Phillips, 2009; Sekhon et al., 2010c). In addition, residual phosphine concentrations in dry cured hams that were fumigated for 48 hrs at 1000 ppm were below 0.01 ppm, the legal residual limit in stored food products (Sekhon, et al. 2009b; Sekhon et al., 2010c), and consumer panelists could not detect differences between control and phosphine fumigated samples at 1000 ppm (Sekhon et al. 2009b; Sekhon et al., 2010c). Therefore, phosphine can now be considered a potential alternative to methyl bromide for controlling arthropod pests of southern dry cured hams. Further testing with a greater number of mites has indicated that a greater concentration of phosphine (>1000 ppm) is likely necessary to kill substantial mite infestations. In addition, commercial applications of phosphine are planned for 2010-2011 to determine the efficacy of using phosphine at the plant level. The effectiveness of phosphine will be evaluated through the use of both bioassays (with ham present) and on hanging hams in a simulated dry cured ham aging room.

Other portions of this research include the economical analysis of using phosphine in comparison to methyl bromide, if it is effective at eradicating mites. Commercial applicators and agricultural economists are working with us on this portion of the research. Additional items that will be researched in the future (if funding is obtained) include the effect of multiple fumigations on the sensory quality and residual concentration of phosphine in ham, and the effectiveness of using phosphine in dry cured ham facilities. Many processors have indicated that they would be willing to help evaluate the efficacy of phosphine (at controlling ham mite infestations) in their plant as part of a research project. In addition, we have commitments from Universities and a commercial applicator to help implement phosphine fumigation in dry cured ham facilities for this research to take place.

Ozone concentrations of greater than 150 ppm for 48 hrs were able to achieve 100 % mortality of ham beetles and mites at the bench top level (Sekhon et al., 2009b; Phillips, 2009; Sekhon et al., 2010b). Consumers also could not determine sensory differences between control hams and those that were fumigated with ozone at 175 ppm for 48 hrs (Sekhon et al., 2010b)). However, ozone is not able to penetrate surfaces well and therefore may not be effective in real world applications since ham mites could potentially penetrate into crevices in the meat and ham beetles bore through the meat tissue. Research that was conducted by one dry cured ham processor indicated that the use of ozone in a commercial setting was not effective at eradicating ham mite infestations, which was likely due to the inability of the ozone to penetrate the surface of the ham and the ability of mites to find places to hide where the ozone did not reach. However, ozone may have use as part of hurdle technology to help minimize infestations and enhance sanitation since it would sanitize areas in the plant as well as equipment that could potentially harbor bugs and pathogens.

Further research has recently been conducted on the effects of low pressure and low oxygen concentration on the mortality of *Tyrophagus putrescentiae* (mold mites). Exposure of mites to low oxygen with pressure (25 mmHg; approx. 3.0% O_2) at 23°C for 144 hrs or greater was effective at eradicating more than 95 % of each mite life stage (Hasan et al., 2010). However, testing with a larger number of mites and under commercial conditions would need to be conducted to determine if this technology could be considered a potential alternative to methyl bromide. Its limitations include length of application, ability of mites to hide within meat crevices, and difficulty in implementing at the commercial plant level.

Census of Pork Producers

In May 2012, Dr. Wes Schilling (Mississippi State University) had 26 country ham producers respond to his survey (U.S. Country Ham Facility Survey) concerning use of methyl bromide in their facilities. These data provide the size of the aging rooms, the yearly amounts of methyl bromide used, and the number of fumigations per year, by facility as requested by MBTOC. Facilities use multiple treatments per year because new hams are brought into the aging rooms throughout the year and multiple outbreaks may occur.

The producers monitor the aging rooms for evidence of pests, and when signs of pests are present they make the decision to fumigate. Typically they clean and seal the aging room on Friday. Gas is introduced after workers leave on Friday afternoon. Aeration usually begins on Sunday afternoon.

Table 3. U.S. Country Ham Facility Survey Conducted by Dr. Schilling, May 2012

Facility #	Maximum MeBr used per year (kg)	Aging Room Size (1,000 cubic meters)	Maximum number of fumigations per year	MeBr capped at 20 kg/1,000 m3 + 10%
1	55	0.64	4	56
2	272	2.61	5	287
3	91	0.85	4	75
4	681	6.37	4	561
5	55	0.57	4	50
6	50	0.57	4	50
7	45	0.57	4	88
8	64	0.57	4	50
9	272	2.83	4	249
10	1135	7.70	5	847
11	27	0.28	4	25
12	27	0.28	4	25
13	68	0.57	4	50
14	272	2.83	4	249
15	18	0.17	4	15
16	14	0.14	4	12
17	45	0.42	4	37
18	45	0.45	4	40
19	23	0.28	4	88
20	64	0.71	4	62
21	114	1.27	4	112
22	36	0.34	4	30
23	81	0.79	4	70
24	27	0.85	2	35
25	27	0.85	2	35
26	55	1.46	2	41
Total	**3,667**	**35.0**		**3,240**

Footnote: These numbers were rounded by Excel spreadsheet after conversion from the original U.S. units.

The data in Table 3 represent responses by 26 country ham producers. We believe there are approximately 28 ham producers in the United States and that the survey therefore represents over 90% of the sector. The standard presumption for use in post-harvest treatments is 20 kg/1000 m^3 (Handbook on Critical Use Nominations for Methyl Bromide, 2007). Several of the facilities listed in Table 3 appear to be conducting fumigations at rates that are higher than the standard presumption. Facilities can undertake efforts to maximize their gas tightness and thereby aim to bring their use rate to within the standard presumption. The United States nomination is calculated by reducing the use rate to 20 kg/1000 m^3 plus 10% as described by MBTOC "a dosage of 20 g/m3, plus a 10% allowance for occasional unforeseen requirement for additional MB due to inclement weather or the sudden need for an extra treatment at a particular facility or possibly for one or two facilities not included in, or responding in time to, the survey, summed up as 10% for contingency measures" (MBTOC 2012, pg. 56).

4. REGISTRATION UPDATE

No new chemicals have been registered or de-registered since the last nomination.

5. ECONOMIC INFEASIBILITY OF ALTERNATIVES

An economic analysis was not conducted because this sector has no technically feasible alternatives at this time.

CITATIONS

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